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**Patentanmeldung Nr. Patent application No. Demande de brevet n°**

02080581.8

**PRIORITY DOCUMENT**
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Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
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(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
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**Electrochemical energy source integrally formed up in a non-conductive casing and method of manufacturing of such an lectrochemical energy source**

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# Electrochemical energy source integrally formed in a non-conductive casing and method of manufacturing of such an electrochemical energy source



The invention relates to an electrochemical energy source integrally formed in a non-conductive casing, comprising: a first current collector embedded in said casing and further coupled to an anode, a second current collector embedded in said casing coupled to a cathode, and an electrolyte and a separator between said anode and said cathode, wherein the casing comprises a portion of a housing of an electronic device. The invention further relates to a method of manufacturing an electrochemical energy source integrally formed in a non-conductive casing, wherein the casing comprises a portion of a housing of an electronic device, comprising the steps of: A) applying of at least one electrochemical cell to said casing, which electrochemical cell comprises an anode, and a cathode, B) realizing a suited configuration for said electrochemical cell, C) applying an electrolyte to said casing, and D) adapting the orientation of said casing in such a manner that said formed electrochemical energy source is at least substantially surrounded by said casing.

An electrochemical energy source, such as a battery, which is integrated in a part of a housing of an electric appliance is already disclosed in the American patent publication US 5,180,645. To provide an integrated battery (permanently) built into or as a part of an equipment housing has numerous advantages. An integrated battery results commonly in a smaller overall size, lighter overall weight, and lower fabrication cost of the electronic device. However, beside these advantages the known electrochemical energy source which is integrally formed with a part of a housing of an electronic device has several drawbacks. One of the drawbacks is the relatively restrictive degree of freedom of design since the choice of a desirable shape and/or format is extremely limited, namely merely flat batteries. Therefore the shape of the housing of said electronic device is commonly adapted to the shape and format of batteries suitable for that specific device.

It is an object of the present invention to provide an improved electrochemical energy source which can be applied in an electronic device having an arbitrary shape and thus without incurring the described drawback while preserving the advantages of the prior art.

The object is achieved by an electrochemical source as described in the preamble characterized in that the electrochemical energy source has a curved, plane geometry. A major advantage of the electrochemical energy source having a curved, plane geometry is that any desired shape of said electrochemical energy source can be realized so that the freedom of choice as regards shape and format of said electrochemical energy source is many times greater than the freedom offered by the state of the art. The geometry of said electrochemical energy source can thus be adapted to spatial limitations imposed by any electrical apparatus in which the battery can be used, in contrary to the techniques known of the prior art. From a point of view of space, in many cases electrical apparatus can now be more efficiently configured because of the greater freedom as regards the choice of the geometry of electrochemical energy source; this may lead to a saving of space in and greater freedom of design of the apparatus. It is to be noted that the curved plane geometry results in a curved battery which has a curved plane shape which may be concave/convex or wavy. However, it also imaginable for a person skilled in the art to apply an angular battery which has a hooked shape. The electrochemical energy source according to the invention may comprise rechargeable batteries, such as Li- or NiMH-batteries, non-rechargeable batteries, and supercapacitors. Said casing can comprise any non-conductive material, but is preferably manufactured of polymer, ceramic, composites, glass, metal provided with a non-conductive layer, or wood. The electrolyte can be formed by a solid state electrolyte. In this case the separator is commonly formed by the solid state electrolyte. Preferably, a liquid state electrolyte is used in the electrochemical energy source according to the invention. In this embodiment the separator is commonly soaked with said liquid state electrolyte.

In a preferred embodiment the electrochemical energy source comprises a laminate of said anode and said cathode, characterized in that the lamination has a curved shape such that the lamination is situated in one curved plane. In this way relatively thin and elongated laminates can be provided in an relatively simple manner.

In another preferred embodiment the electrochemical energy source comprises at least one assembly of electrochemical cells electrically coupled together, each cell comprising said anode, said first current collector, said cathode, said second current collector, and said electrolyte and said separator situated between said anode and said cathode, and insulation means for insulating one cell within said assembly from another cell within said assembly. Each assembly of electrochemical cells or each single electrochemical cell enclosed in a separate housing is also known as a battery. Each cell or each battery can for example be manufactured in advance and can be applied in the energy source when desired.

The shape of each cell and each battery can be arbitrary. The overall assembly of cells (and batteries) determines the final shape of the electrochemical energy source. Preferably, more assemblies of cells and/or batteries electrically coupled together are applied. In a particular preferred embodiment a pack of batteries is applied, said batteries electrically coupled together, wherein each battery comprises at least one electrochemical cell. Said pack can thus have any desired shape determined by the orientation of batteries in said pack. In a preferred embodiment at least a part of said assemblies or pack is formed by conventional batteries. In this way conventional batteries can be applied to form the electrochemical energy source according to the invention. Said conventional batteries can also be formed by a specific configuration of one or more cells. In a particular alternative embodiment said battery comprises a specific single electrochemical cell, also known as a "bicell". These bicells or other batteries can for example be manufactured by way of the known "Bellcore" technology, "gel" technology or "Lithylene" technology. It must be noted that, in case more batteries are applied, the batteries can be electrically coupled either in a serial way or in a parallel way. The electrochemical cells within each assembly or battery can also be coupled electrically in a manner (serial or parallel) that depends on the needs of (said housing of) said electronic device. Thus, within the scope of the present invention different configurations of cells and batteries can be applied with different electrical connections which can be applied in different electronic devices with different needs.

The invention also relates to a method of the kind set forth in accordance with the invention characterized by that realizing a suited configuration for said electrochemical cell according to step B) is occurred in such a manner that said electrochemical cell exhibits a curved, plane geometry. The advantages of a curved, plane geometry are already described above. The applying of said anode and anode on the casing can be realized in different manners. A common manner to apply the active electrodes on the casing is by physical deposition techniques and by silk screening and painting. It is also imaginable to apply conventional (porous) electrodes. The adapting of the configuration of said casing according to step D) can for example be realized by (ultrasonic) welding, diode "lasering", mechanical deforming, thermal treatment, or polymerising of liquid state polymers. As already mentioned above, it is imaginable to apply conventional (pre-assembled) batteries, such as to aforementioned bicells and batteries, to the casing according to step A). The applying of said electrolyte according to step C) can be realized in a conventional manner. Optionally, the applying of said electrolyte according to step C) is subjected to a vacuum treatment. In case said electrolyte is a solid state electrolyte, said solid state electrolyte forms commonly also a

separator for separation of said anode and said cathode. In case a liquid state electrolyte is used, an additional separator must be applied. The application of a (separate) separator can be incorporated in step A), though is preferably incorporated in step C). Said separator may either comprise a single separator as used for example in Li-ion and NiMH batteries or comprise a separator adapted for lamination as used for example in Li-ion and NiMH based on the Bellcore technology, polymer gel technology, Lithylene half manufactures, and "UHMW" technology. In case a separator adapted for lamination is used mechanical stable batteries can be formed *in situ* by subjecting said formed batteries to a thermal treatment.

In a preferred embodiment said electrochemical cell comprises an impermeable sheet surrounding said anode and said cathode. The impermeable sheet can either be applied in advance in the casing or can be applied to said electrochemical cell before applying said cell to said casing according to step A). In particular, the impermeable sheet is adapted to prevent leaking of an (liquid state) electrolyte out of said cell at one side and prevent intrusion of moisture and air out of the local atmosphere into said cell at the other side. Said impermeable sheet can be manufactured of an assembly of metal and/or polymer sheets. Optionally, the impermeable sheet is integrated with the casing of the electrochemical energy source during (injection) molding of said casing.

During the application of said electrochemical cell to said casing according to step A) multiple electrochemical cells are applied to said casing. The electrochemical cells are thereby electrically coupled thereby forming a battery. In this manner more batteries can be applied to said casing, each battery comprising more electrochemical cells. Said batteries are electrically coupled in a serial or parallel way. The coupling of cells is preferably realized in advance. As mentioned afore said cells may comprise pre-assembled cells or may comprise occasionally made cells.

In a last preferred embodiment is the electrochemical cell subjected to a thermal treatment before said electrolyte and separator are applied to said casing according to step C). In such a manner a stable electrochemical cell can be created. Possible techniques to form a mechanical stable cell or battery of cells are already mentioned above.

The invention will be illustrated by way of the following non-restrictive examples.

Fig. 1 shows a curved battery which is permanently positioned in and completely integrated with a housing of a domestic mixer; and

Fig. 2 shows a curved battery of pre-assembled electrochemical cells which is integrated in a chamber of a housing of a celest, an apparatus for removing cellulites formed on body parts.

Figure 1 shows a curved battery 1 which is permanently positioned in and completely integrated with a housing 2 of a domestic mixer 3. Said curved battery 1 is adapted to the need of the appliance, in particular said mixer 3, to accommodate an electrochemical energy source in an efficient and less voluminous manner. Said curved battery 1 can be of different types, but is preferably rechargeable in this application. Said curved battery 1 comprises an assembly of an anode, a cathode and an electrolyte and separator means, which assembly is not visualized in figure 1. Said assembly is hermetically packed in an impermeable sheet 4 to prevent leakage of substance out of said battery 1 at one hand and to prevent intrusion of air, moisture and other substances into said battery at the other hand. The method of manufacturing of said battery 1 in said housing 2 as well as further advantages are already described in detail above.

Figure 2 shows a curved battery 5 of pre-assembled electrochemical cells 6 which is integrated in a chamber 7 of a housing 8 of a celest 9, an apparatus for removing cellulites formed on body parts. The cells 6 are all (electrically) serially coupled by way of conductive wires 10. Preferably, all cells 6 are rechargeable. Advantageous of this embodiment is that with conventional and relatively cheap batteries a curved battery 5 can be formed, which, in general, can be adapted to the need of and internal space in a housing of an electronic device. Noted is that said curved battery 5 is fixed permanently in said chamber 7 of said housing 8. The providing of said curved battery 5 built into said housing 8 results commonly in a smaller overall size, lighter overall weight, and lower fabrication costs of said celest cleaner 9.

CLAIMS:



1. Electrochemical energy source integrally formed in a non-conductive (40) casing, comprising:

- a first current collector embedded in said casing and further coupled to an anode,
- a second current collector embedded in said casing coupled to a cathode, and
- an electrolyte and a separator between said anode and said cathode,

wherein the casing comprises a portion of a housing of an electronic device, characterized in that the electrochemical energy source has a curved, plane geometry.

2. Electrochemical energy source according to claim 1, characterized in that the electrochemical energy source comprises a laminate of said anode and said cathode, characterized in that the lamination has a curved shape such that the lamination is situated in one plane.

3. Electrochemical energy source according to one of the foregoing claims, characterized in that said electrolyte is a liquid state electrolyte.

4. Electrochemical energy source according to one of the foregoing claims, characterized in that the electrochemical energy source comprises

- at least one assembly of electrochemical cells electrically coupled together, each cell comprising said anode, said first current collector, said cathode, said second current collector, and said electrolyte and said separator situated between said anode and said cathode, and
- insulation means for insulating one cell within said assembly from another cell within said assembly.

5. Electrochemical energy source according to claim 4, characterized in that at least one assembly is formed by a conventional battery.

6. Electrochemical energy source according to claim 4 or 5, characterized in that a pack of batteries is applied, said batteries electrically coupled together, wherein each battery comprises at least one electrochemical cell.

7. Method of manufacturing an electrochemical energy source integrally formed in a non-conductive casing, wherein the casing comprises a portion of a housing of an electronic device, comprising the steps of:
A) applying of at least one electrochemical cell to said casing, which electrochemical cell comprises an anode, and a cathode,
B) realizing a suited configuration for said electrochemical cell,
C) applying an electrolyte to said casing, and
D) adapting the orientation of said casing in such a manner that said formed electrochemical energy source is at least substantially surrounded by said casing,
characterized by that realizing a suited configuration for said electrochemical cell according to step B) is occurred in such a manner that said electrochemical cell exhibits a curved, plane geometry.

8. Method according to claim 7, characterized in that, said electrochemical cell comprises an impermeable sheet surrounding said anode and said cathode.

9. Method according to one of the foregoing claims 7 or 8, characterized in that, during the application of said electrochemical cell to said casing according to step A) multiple electrochemical cells are applied to said casing.

10. Method according to one of the foregoing claims 7-9, characterized in that, before said electrolyte is applied to said casing according to step C) the electrochemical cell is subjected to a thermal treatment.

ABSTRACT:



The invention relates to an electrochemical energy source integrally formed in a non-conductive casing, comprising: a first current collector embedded in said casing and further coupled to an anode, a second current collector embedded in said casing coupled to a cathode, and an electrolyte and a separator between said anode and said cathode, wherein the casing comprises a portion of a housing of an electronic device. The invention further relates to a method of manufacturing an electrochemical energy source integrally formed in a non-conductive casing, wherein the casing comprises a portion of a housing of an electronic device, comprising the steps of: A) applying of at least one electrochemical cell to said casing, which electrochemical cell comprises an anode, and a cathode, B) realizing a suited configuration for said electrochemical cell, C) applying an electrolyte to said casing, and D) adapting the orientation of said casing in such a manner that said formed electrochemical energy source is at least substantially surrounded by said casing.

Fig. 1

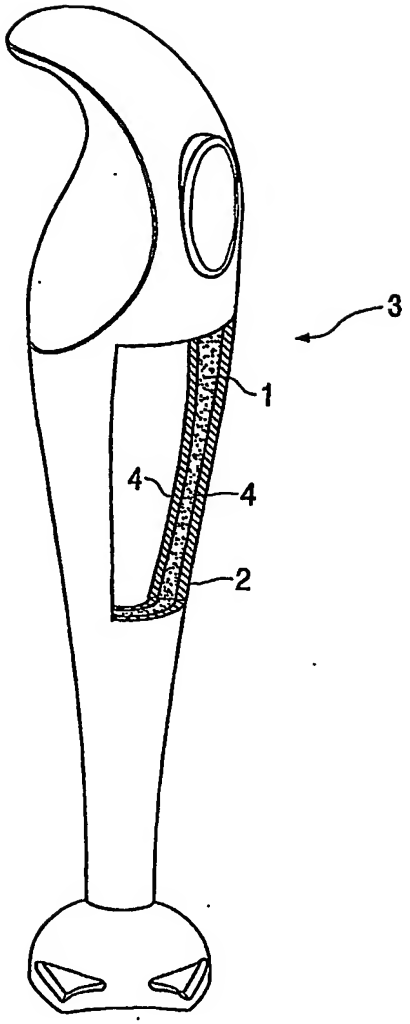


FIG. 1

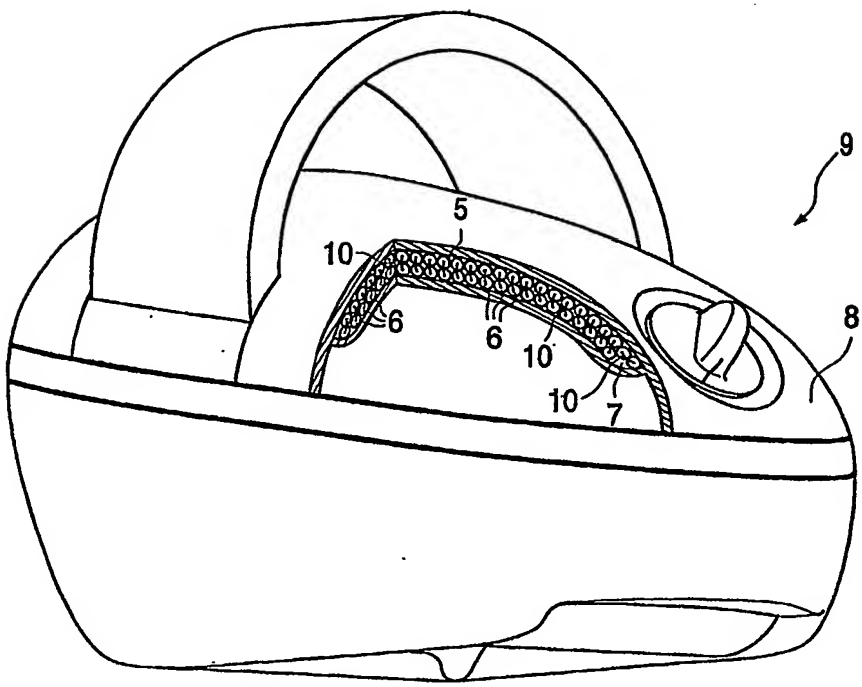


FIG. 2